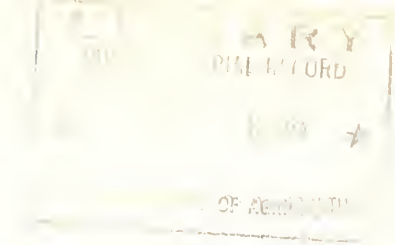


Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

845m
p. 3



Measuring Cotton Fiber Length

THE TRUNCATED ARRAY METHOD

UNITED STATES DEPARTMENT OF AGRICULTURE

Agricultural Marketing Service

Marketing Research Division

Marketing Research Report No. 217

CONTENTS

	<u>Page</u>
Summary and conclusions-----	iii
Introduction-----	1
The various methods and techniques investigated-----	1
I. The "Short" Suter-Webb array method-----	1
II. The modified Suter-Webb array technique-----	2
III. Modal length-----	3
IV. The truncated array-----	3
Evaluation of the truncated array in relation to processing performance and other measures of length-----	7
Procedure for the truncated array and its application-----	10
Appendix-----	12

- ooOoo -

ACKNOWLEDGMENTS

This study was planned and conducted under the administrative direction of John W. Wright, Chief, Standards and Testing Branch, Cotton Division, who has since retired. Appreciation is expressed to members of the Washington and field laboratories for assistance in obtaining data for this study.

Washington, D. C.

March 1958

For sale by Superintendent of Documents, U. S. Government Printing
Office, Washington 25, D. C.

Price 15 cents

SUMMARY AND CONCLUSIONS

This report is a summary of the investigation and evaluation of several suggested techniques and methods for measurement of the length of fibers in a sample of cotton. The study is part of a broad, continuing program of research to find or develop more efficient and more economical methods and practices in marketing cotton and other major farm products.

In this study, a shorter technique for measuring the length of the fibers in a sample of cotton, called the truncated array technique, was compared with three other methods, including the customarily used Suter-Webb array method. The truncated array technique was found to provide results which are more valuable in several respects than the other methods studied, and to save about 15 percent of the time required for the usual Suter-Webb procedure. The truncated array technique is a variation of the widely used Suter-Webb array method and uses the same equipment.

The various techniques and methods studied included the "Short" Suter-Webb array method, the modified array technique, the use of modal length as a length designation value, and the truncated array technique with "cutoff" points of $5/8$ inch, $1/2$ inch, $3/8$ inch, and $1/4$ inch.

The truncated array values for the "cutoff" points of $5/8$ inch, $1/2$ inch, $3/8$ inch, and $1/4$ inch appeared to be the most promising of the experimental methods and were used in multiple and partial correlation analyses with 22's yarn skein strength, 22's yarn appearance grade, and picker and card waste. The calculated values used for each "cutoff" point in these analyses were: Percentage of fibers equal to or longer than the "cutoff" point, mean length, and $75/25$ length ratio of these fibers. The truncated array with the $1/2$ -inch "cutoff" point appeared to provide the most significant overall values for length and for length uniformity in relation to the processing results. Multiple and partial correlation analyses were made of the truncated array values for "cutoff" points of $5/8$ inch, $1/2$ inch, and $1/4$ inch, substituting the coefficient of length variability for the $75/25$ length ratio, with 22's yarn skein strength and 22's appearance grade.

A time study showed that the coefficient of length variability could be calculated more expeditiously than the $75/25$ length ratio.

The truncated array for the $1/2$ -inch "cutoff" point with the calculated values of the percentage of fibers $1/2$ inch long and longer, mean length, and coefficient of length variability of these fibers was arbitrarily selected for further study and evaluation as the truncated array.

The truncated array values are more meaningful and were found to be more expeditious than the standard Suter-Webb array values. Repeatability is the same or better for the truncated array than for the standard Suter-Webb array values, based on calculations from the same 60 cottons tested by both methods.

Multiple, partial, and simple correlation analyses of the truncated array values, standard Suter-Webb array values, Fibrograph measurements, and classer's length, with 22s yarn skein strength, 22s yarn appearance grade, and picker and card waste, showed the truncated array values to be more valuable than the other length values for explaining the variation in each of the spinning qualities. The truncated array values also explain more of the variation in 50s yarn skein strength and 50s yarn appearance grade than the standard Suter-Webb array values.

There is no significant difference between the various laboratory length measures from the standpoint of relationship to classer's staple length designations. Correlation coefficients are relatively low in all instances.

According to the beta coefficients, mean length, regardless of the kind of array, ranked first in importance in the array values in relation to 22s yarn skein strength and picker and card waste. The percentage of long fibers is most significant from the standpoint of yarn appearance.

The truncated array technique is more expeditious than the standard Suter-Webb array procedure, requiring approximately 15 percent less time for a test. It is not rapid enough to replace the Fibrograph test.

In order to avoid confusion with the standard Suter-Webb array value of the coefficient of length variability, the reporting value used for the length variability for the truncated array will be the index of length uniformity, which is 100 minus the calculated coefficient of length variability.

A description of the truncated array technique is given in this report. The truncated array technique may be used for all tests for cotton fiber length where, previously, the standard Suter-Webb array upper quartile length, mean length, and coefficient of length variability were adequate. For length tests requiring other values, the standard Suter-Webb array procedure must be followed.

MEASURING COTTON FIBER LENGTH: THE TRUNCATED ARRAY METHOD

By Frances Carpenter and Samuel T. Burley, Jr.
Cotton Technologists

INTRODUCTION

For many years, the Suter-Webb array method has been considered the most accurate method available for measuring cotton fiber length. This method, though widely used, is tedious and time-consuming. Many attempts have been made to develop a more rapid method which did not sacrifice the accuracy necessary in a test of this kind. The Fibrograph provides a more rapid method for length determination, but it has certain limitations.

It is thought that the present calculated values for the standard Suter-Webb length arrays are not the most effective values for expressing the fiber length and length uniformity of a sample of cotton.

The purpose of this study was to evaluate suggested techniques, such as the "Short" Suter-Webb array $1/$, modified array technique, and suggested methods for calculating more useful measures of length, such as modal length and truncated arrays using $5/8$ inch, $1/2$ inch, $3/8$ inch, and $1/4$ inch as "cutoff" points for calculations made on the Suter-Webb array data.

The evaluation not only included analyses as to the most meaningful test, but also included the time required to make the tests.

THE VARIOUS METHODS AND TECHNIQUES INVESTIGATED

I. The "Short" Suter-Webb array method. The "Short" Suter-Webb array method has been in use for several years and, for some purposes, is reported to be a satisfactory method for length determination. This method is a modified Suter-Webb array method using the same machine and equipment except that the machine is modified by placing another comb $1/16$ inch in front of the first comb of the right-hand bank of combs. All other combs should be $1/8$ inch apart, since the distance between combs is used as a unit of measurement in designating the length of fibers.

The "Short" Suter-Webb array method was investigated, first by 1 technician testing 19 official standards for staple length, then by 3 technicians using the same samples of cotton.

1/ Merenes, H. A. Comparison of Cotton Staple Lengths by the Standard Suter-Webb Array Method and by the "Short" Suter-Webb Array Method. Institute of Textile Technology, Report 14, March 1957.

The specimen is prepared as for the standard Suter-Webb array test and is spread over the entire width of the left bank of combs when it is placed in the machine. One transfer is made, keeping all the proximal ends of the fibers within 1/16 inch of the first comb in the right-hand bank. The machine is rotated 180° and all of the fibers in front of the first comb are withdrawn and placed in a black paper for weighing. The next comb is dropped and the fibers are withdrawn and placed in a separate black paper. This process is repeated until all the fibers have been removed from the machine. The combs are used to designate length groups instead of measuring the length of each "pull" as for the Suter-Webb array. Each black paper must be carefully marked with comb designation and weighing must be done in order to determine the proper weights for the length groups. The same calculations can be made as for the standard Suter-Webb arrays, and other calculations can also be made, such as 50 percent point, 75 percent point, percentage of fibers shorter or longer than a given length, or 75/25 ratio, or other values as desired. For this study, the 25 percent point and 75/25 length ratio were calculated.

This method did not prove to be an improvement over the standard Suter-Webb array. There was less difference in the time required for performing a test by the two methods than had been assumed. The addition of the front comb made sorting more difficult for the "Short" array. The results for the "Short" array tests were on different levels for each technician, and for one technician were more erratic than for the standard Suter-Webb array tests. For the "Short" array, the fibers were found to be very poorly sorted as to length and this method did not prove to be rapid enough or sufficiently accurate to replace the present standard method.

II. Modified Suter-Webb array technique. The modified technique was the same as the standard Suter-Webb array method for sorting the fibers, but the "Short" Suter-Webb array technique was used for extracting, weighing the fibers, and calculating results. This technique was investigated by 3 technicians performing tests on 19 official standards for staple length. Tests were made in three-fourths of the time required for the standard Suter-Webb array. Eleven technicians in 3 other fiber laboratories making array tests were given instructions and practice for the modified array technique. Samples from the 19 staple types were tested by each of them. Repeatability was not as good as for the standard array, but there was a time saving. Technicians with the most experience in using the standard Suter-Webb array procedure produced the most satisfactory results by the modified technique. Technicians with a limited amount of experience produced more erratic results by the modified technique.

Three technicians at the Washington laboratory also tested 71 cottons previously tested by the standard Suter-Webb array procedure. Length determinations by the modified array technique could be performed in three-fourths of the time required by the standard Suter-Webb array procedure, but the results were not as accurate.

Tests were performed on 16 regularly scheduled check test samples by 14 technicians in 4 laboratories where length tests are performed. The average difference between all sample averages at the 4 laboratories was

the same for both the modified array technique and the standard Suter-Webb array procedure, being .034 inch. ^{2/} The average difference between the minimum and maximum values for technicians for all samples was .065 inch for the standard Suter-Webb array upper quartile length and .112 inch for the modified array 25 percent point. This greater variation for the modified array technique was caused by the variation in the length of the ends of fibers remaining in front of the front comb after the second transfer had been completed. In the calculations, 1/16 inch was allowed for these fibers and, if they protruded more than this amount on 1 array, this array would vary from the other arrays. The effect of the protruding fibers is minimized when the "pulls" of the standard Suter-Webb array are actually measured with a ruler, instead of designating length by combs as is done for the modified array.

III. Modal length. The modal length in inches was calculated from the data obtained from the standard Suter-Webb array tests on the 71 cottons also tested by the modified array technique. The following formula was used: ^{3/}

$$\text{Modal length in inches} = L_1 + \left(\frac{\Delta_1}{\Delta_1 + \Delta_2} \times i \right) \times .0625,$$

Where L_1 = the lower limit of the array group containing the highest weight in an array.

Δ_1 = the difference between the relative weight of 1/16 inch of fibers in the modal group, or group containing the highest weight, and the relative weight of 1/16 inch of fibers in the next shorter group.

Δ_2 = the difference between the relative weight of 1/16 inch of fibers in the modal group and the relative weight of 1/16 inch of fibers in the next longer group.

$i = 2$ (there are two 1/16 inch intervals in each length group).

The results of these calculations were not satisfactory as length measurements because of the wide variation between findings of different technicians. The average of technician differences obtained on 71 samples tested at 1 laboratory was .037 inch for the standard array upper quartile length and .070 inch for modal length.

IV. The truncated array. In this phase of the study, data from standard Suter-Webb array tests made on 60 cottons representing a wide range of fiber properties were used in calculating values for 4 kinds of

^{2/} There were 15 samples tested at the Stoneville, Miss., laboratory.

^{3/} Applied General Statistics, Croxton and Cowden, p. 213.

truncated arrays. Lengths of 5/8 inch, 1/2 inch, 3/8 inch, and 1/4 inch were used as "cutoff" points in the array, making 4 kinds of truncated arrays. Fibers equal to and longer than the "cutoff" point were treated as a specimen and the remaining lengths were ignored except in the calculation of the percentage of fibers equal to or longer than the "cutoff" point. 4/

The values calculated for each kind of truncated array included the percentage of fibers equal to or longer than the "cutoff" point, the mean length of these fibers, and the 75/25 length ratio. The 75/25 length ratio is obtained by dividing the length at the 75 percent point of the fibers of the "cutoff" point and longer, by the length at the 25 percent point of these fibers, and multiplying by 100.

A summary of the multiple correlation coefficients for each of these 4 kinds of truncated array values with 22s yarn strength, 22s yarn appearance grade, and picker and card waste, respectively, as dependent variables is shown in table 1.

Table 1.--A summary of multiple correlation coefficients for each of 4 kinds of truncated arrays with 22s yarn skein strength, 22s yarn appearance grade, and picker and card waste, respectively, as dependent variables

Factors of cotton quality	: Multiple correlation coefficient $\bar{R}$
22s yarn skein strength with: <u>1/</u>	:
Truncated array with the 75/25 length ratio:	:
(a) 5/8-inch "cutoff" point	: + .813 $\pm$.034
(b) 1/2-inch "cutoff" point	: + .821 $\pm$.042
(c) 3/8-inch "cutoff" point	: + .795 $\pm$.048
(d) 1/4-inch "cutoff" point	: + .804 $\pm$.046
22s yarn appearance grade with: <u>1/</u>	:
Truncated array with the 75/25 length ratio:	:
(a) 5/8-inch "cutoff" point	: + .396 $\pm$.110
(b) 1/2-inch "cutoff" point	: + .354 $\pm$.114
(c) 3/8-inch "cutoff" point	: + .370 $\pm$.112
(d) 1/4-inch "cutoff" point	: <u>2/</u> + .324 $\pm$.117
Picker and card waste with: <u>1/</u>	:
Truncated array with the 75/25 length ratio:	:
(a) 5/8-inch "cutoff" point	: + .546 $\pm$.091
(b) 1/2-inch "cutoff" point	: + .538 $\pm$.092
(c) 3/8-inch "cutoff" point	: + .560 $\pm$.089
(d) 1/4-inch "cutoff" point	: + .589 $\pm$.085
	:

1/ The following calculated values were used as independent variables for each kind of truncated array: Percentage of fibers, mean length, and 75/25 length ratio

2/ Statistically insignificant, being less than 3 times its standard error.

4/ A summary of the data pertaining to the variables in the simple, multiple, and partial correlation analyses will be found in table 8 in the appendix.

The truncated array with the 1/2 inch "cutoff" point explained more of the variation in 22s yarn skein strength than the other kinds of truncated array values, although the differences are not statistically significant. All of the correlation coefficients for 22s yarn appearance grade are low, but are statistically significant coefficients except for the 1/4 inch "cutoff" point. The truncated array values for the 1/2 inch "cutoff" point explain slightly less variation in picker and card waste than the values for the other "cutoff" points, but the difference is not statistically significant. The truncated array values for the 1/2 inch "cutoff" point for this series of analyses appears to provide the most significant overall length values.

Since the standard Suter-Webb array values include the coefficient of length variability as the measure of length variability in a sample of cotton, analyses were made of the importance, to the 22s yarn skein strength and 22s yarn appearance grade, of the truncated array values for the 5/8 inch, 1/2 inch, and 1/4 inch "cutoff" points, substituting the coefficient of length variability for the 75/25 length ratio. The results of these analyses are shown in table 2. The beta coefficients for these relationships are in tables 9 and 10, respectively, in the appendix. The mean length, regardless of the kind of array or variability measurement used, ranked first in importance to 22s yarn skein strength.

Table 2.--A summary of the multiple correlation coefficients for 3 kinds of truncated arrays, substituting the coefficient of length variability for the 75/25 length ratio, in the analyses with 22s yarn strength and 22s yarn appearance grade as dependent variables

Factors of cotton quality	: Multiple correlation : coefficient $\bar{R}$
22s yarn skein strength with: <u>1/</u>	:
Truncated array with:	:
(a) 5/8-inch "cutoff" point	: + .850 + .036
(b) 1/2-inch "cutoff" point	: + .807 + .045
(c) 1/4-inch "cutoff" point	: + .800 + .047
22s yarn appearance grade with:	:
Truncated array with:	:
(a) 5/8-inch "cutoff" point	: + .434 + .106
(b) 1/2-inch "cutoff" point	: + .371 + .112
(c) 1/4-inch "cutoff" point	: + .376 + .111
	:

1/ The following calculated values were used as independent variables for each kind of truncated array: Percentage of fibers, mean length and coefficient of length variability.

The truncated array values for the 5/8 inch "cutoff" point using the coefficient of length variability as the measure of length variability, explained more of the variations in 22s yarn skein strength and 22s yarn appearance grade than the truncated array values for the other "cutoff" points. A comparison of the relative percentages of variation in 22s yarn

skein strength that are explained by using each of the measures of length variability for each of the truncated array "cutoff" points is shown in table 3.

Table 3.--Comparison of the relative contribution to 22s yarn skein strength of the truncated array values using the 75/25 length ratio and of the truncated array values using the coefficient of length variability

Kind of variability measurement	:	Percentage of variance explained
5/8-inch "cutoff" point:	:	
75/25 length ratio	:	66.2
Coefficient of length variability	:	72.2
1/2-inch "cutoff" point:	:	
75/25 length ratio	:	67.4
Coefficient of length variability	:	65.1
3/8-inch "cutoff" point:	:	
75/25 length ratio	:	63.2
1/4-inch "cutoff" point:	:	
75/25 length ratio	:	64.7
Coefficient of length variability	:	63.9

A time study was made to determine which of these measures of length variability was more expeditious. It was found that the coefficient of length variability can be calculated at a time saving of approximately 17 percent as compared to the time required for calculating the 75/25 length ratio.

The truncated array with the 1/2 inch "cutoff" point for the calculated values of percentage of fibers 1/2 inch long and longer, mean length, and coefficient of length variability of these fibers, was arbitrarily selected for further study and comparison with the relative importance of length values obtained by other length tests. The truncated array with the 1/2 inch "cutoff" point will be referred to subsequently in this report as the truncated array.

EVALUATION OF THE TRUNCATED ARRAY IN RELATION TO PROCESSING PERFORMANCE AND OTHER MEASURES OF LENGTH

The nature and scope of the data which serve as a basis for the comparison of the standard Suter-Webb array values and truncated array values used in this study are shown below:

<u>Length value</u>	<u>Suter-Webb array</u>	<u>Truncated array</u>
Mean		
High (inches)	1.20	1.27
Low "	.80	.87
Range "	.40	.40
Mean "	.97	1.04
Standard deviation	.074	.069
Coefficient of length variability		
High (percent)	37	25.5
Low "	23	16.3
Range "	14	9.2
Mean "	30.2	20.6
Standard deviation	3.470	1.936

For the 60 cottons studied, the same data were used in calculating both sets of length values. A comparison of these values for mean length and coefficient of length variability shows the average truncated array mean length for the 60 cottons studied is .07 inch longer than the average standard Suter-Webb array mean length for the same cottons. The range between the minimum and maximum values for both techniques is the same, but the standard deviation for the truncated array mean length is smaller than the standard deviation for the standard Suter-Webb array mean length, being .069 and .074 inch, respectively. The average of the coefficients of length variability for the truncated array is 9.6 percent less than the average for the standard Suter-Webb array. Since they are on different levels, a comparison of their standard deviations is confusing, unless the standard deviation is expressed in percentage of the mean coefficient of length variability for each technique. When this comparison was made, it was found that there was a 2.1 percent smaller standard deviation for the truncated array coefficient of length variability than for the standard Suter-Webb coefficient of length variability.

Another time study was made to determine the relative expedience of the truncated array as compared to the standard Suter-Webb array procedure. The truncated array technique requires approximately 15 percent less time

than the standard Suter-Webb array procedure. The time saving is accomplished in the modified technique by not arraying, measuring, or weighing separately the fiber length groups for fibers shorter than 1/2 inch and by calculating the percentage of fibers 1/2 inch and longer instead of calculating the upper quartile length.

Multiple and partial correlation analyses were made of the relationship of the truncated array values, standard Suter-Webb array values, and Fibrograph measurements, each as independent variables, with 22s yarn skein strength, 22s yarn appearance grade, and picker and card waste, each as dependent variables. Simple correlation analyses of classer's length with the same 3 kinds of processing results were made. The results of these analyses are shown in table 4.

Table 4.--Comparison of statistical values representing the relationships between 22s yarn skein strength, 22s yarn appearance grade, and picker and card waste as dependent variables and cotton fiber length as measured by the truncated array, standard Suter-Webb array, Fibrograph, and classer's length as independent variables

Values correlated	Correlation coefficients	
	$\bar{r}$	$\bar{R}$
22s yarn skein strength with:		
1. Truncated array: <u>1/</u>		+0.807 $\pm$.045
2. Standard Suter-Webb array: <u>2/</u>		+ .756 $\pm$.056
3. Fibrograph: <u>3/</u>		+ .684 $\pm$.069
4. Classer's length:	+0.505 $\pm$.097	
22s yarn appearance grade:		
1. Truncated array: <u>1/</u>		+ .371 $\pm$.112
2. Standard Suter-Webb array: <u>2/</u>		+ .365 $\pm$.113
3. Fibrograph: <u>3/</u>		<u>4/</u> + .113 $\pm$.128
4. Classer's length:	<u>4/</u> + .190 $\pm$.125	
Picker and card waste:		
1. Truncated array: <u>1/</u>		+ .555 $\pm$.090
2. Standard Suter-Webb array: <u>2/</u>		+ .523 $\pm$.095
3. Fibrograph: <u>3/</u>		+ .509 $\pm$.097
4. Classer's length	<u>4/</u> + .533 $\pm$.093	

1/ The truncated array values used as independent variables were: Percentage of fibers 1/2 inch and longer, mean length, and coefficient of length variability.

2/ The standard Suter-Webb array values used as independent variables are: Upper quartile length, and coefficient of length variability.

3/ The Fibrograph values used as independent variables were: Upper half mean length and length uniformity ratio.

4/ Statistically insignificant being less than 3 times its standard error.

The beta coefficients for these relationships are shown in tables 9, 10, and 11, respectively, in the appendix. The beta coefficients show mean length values to be most significant from the standpoint of yarn strength and manufacturing waste, whereas the percentage of long fibers is most significant from the standpoint of yarn appearance. The truncated array

values correlated with 22s yarn strength, 22s yarn appearance grade, and picker and card waste had higher correlation coefficients than for any of the other kinds of length values used in these analyses.

A comparison of the importance of the truncated array values and the standard Suter-Webb array values in relation to 22s and 50s yarn skein strength and yarn appearance grade is shown in table 5.

Table 5.--Correlation coefficients for the relationship of the truncated array values and the standard Suter-Webb array values, as independent variables, with 22s and 50s yarn skein strength and yarn appearance grade as dependent variables

Factors correlated	Coefficient of correlation $\bar{R}$	
	22s	50s
Yarn skein strength with:		
1. Truncated array: $\frac{1}{2}$	$0.807 \pm .045$	$0.794 \pm .048$
2. Suter-Webb array: $\frac{2}{2}$	$.773 \pm .052$	$.736 \pm .060$
Yarn appearance grade with:		
1. Truncated array: $\frac{1}{2}$	$.371 \pm .112$	$.633 \pm .078$
2. Suter-Webb array: $\frac{2}{2}$	$.368 \pm .113$	$.606 \pm .082$

1/ The truncated array values used were: Percentage of fibers 1/2 inch and longer, mean length and coefficient of length variability.

2/ The Suter-Webb array values used were: Upper quartile length, mean length, and coefficient of length variability.

The truncated array values have a higher correlation coefficient than the standard Suter-Webb array values, with the processing results for both 22s and 50s yarn.

Multiple and partial correlation analyses were made of the truncated array values, standard array values, and Fibrograph measurements with classer's length as the dependent variable in each analysis. The results are shown in table 6. Statistically, neither of these relationships is better than another for explaining the variation in classer's length.

Table 6.--Results of multiple and partial correlation analyses of classer's length, as the dependent variable, with the truncated array values, standard Suter-Webb array values, and Fibrograph measurements

Properties correlated with classer's length as the dependent variable:	Correlation coefficient $\bar{R}$
1. Truncated array:	$+0.697 \pm .067$
2. Standard Suter-Webb array: Upper quartile length and coefficient of length variability	$+ .698 \pm .067$
3. Standard Suter-Webb array: Mean length and coefficient of length variability	$+ .699 \pm .067$
4. Fibrograph: Upper half mean length and length uniformity ratio	$+ .726 \pm .062$

The results of the truncated array mean length, standard Suter-Webb array upper quartile length, as well as mean length, and Fibrograph upper half mean length, used in simple correlation with classer's length as the dependent variable, are shown in table 7. The Fibrograph upper half mean length shows a slightly higher correlation with classer's length than the other fiber length values used, but it is not significantly better than the other values. The truncated array mean length is more highly correlated with classer's length than the standard Suter-Webb array mean length.

Table 7.--Simple correlation coefficients for the relationship of classer's length, as the dependent variable, with the truncated array mean length; Suter-Webb array upper quartile length, mean length; and Fibrograph upper half mean length

Properties correlated with classer's length	Coefficient of correlation $\bar{r}$
1. Truncated array mean length	+ 0.684 $\pm$.069
2. Standard Suter-Webb array:	
Upper quartile length	+ .691 $\pm$.068
Mean length	+ .646 $\pm$.076
3. Fibrograph upper half mean length	+ .700 $\pm$.066

The percentage of fibers 1/2 inch long and longer was calculated by weight and by relative number of fibers. The 2 are closely related, but the simple correlation coefficient for percentage of fibers calculated by weight, with 22s yarn skein strength, is more significant than the simple correlation coefficient for percentage of fibers, calculated by relative number, with 22s yarn skein strength, being .564 and .417, respectively.

PROCEDURE FOR THE TRUNCATED ARRAY AND ITS APPLICATION

The truncated array procedure is the same as the standard Suter-Webb array procedure except that fibers shorter than 1/2 inch are not arrayed on the black velvet boards, measured, or separated into length groups for weighing, but are lifted from the array machine in one bundle and are weighed. It may be necessary to array 2 or 3 pulls from the 7/16 inch group to be sure all of the fibers which are 1/2 inch long have been removed from the machine and arrayed. These 2 or 3 pulls should be added to the other short fibers to be weighed in 1 bundle. The values to be calculated are: Percentage of fibers 1/2 inch and longer, mean length, and the coefficient of length variability of these fibers. The coefficient of length variability will be reported as index of length uniformity, to avoid confusion with the standard Suter-Webb array value. The index of length uniformity is obtained by subtracting the coefficient of length variability from 100. The value obtained expresses the variation in length, from the mean length, in positive terms.

The truncated array technique may be used for all tests for cotton fiber length where the standard Suter-Webb array upper quartile length, mean length, and coefficient of length variability were adequate. However, for

tests where it is necessary to have the weight of the individual fiber length groups for fibers shorter than $1/2$ inch in order to calculate desired values, the standard Suter-Webb array procedure must be followed.

A P P E N D I X

Table 8.--Summary of data pertaining to independent and dependent variables
used in correlation analyses

Factors used	: Unit	: Mean	: S.D.	: Min.	: Max.	: Range
<u>Independent variables:</u>						
1. Classer's length	32nd in.	33.77	2.432	29.	38.	9.
2. Fibrograph length:						
Upper half mean	Inches	1.08	.078	.87	1.35	.48
Uniformity ratio	Ratio	79.6	1.26	77.	82.	5.
3. Standard Suter-Webb array:						
Upper quartile length	Inches	1.18	.083	.98	1.47	.49
Mean length	Inches	.97	.074	.80	1.20	.40
Coef. of variability	Percent	30.2	3.47	23.	37.	14.
4. Truncated arrays:						
5/8-inch "cutoff" point						
Percentage of fibers	Percent	85.5	4.45	74.0	91.9	17.9
Mean length	Inches	1.06	.066	.90	1.30	.40
Coef. of variability	Percent	17.69	1.562	13.7	21.5	7.8
75/25 length ratio	Ratio	77.2	9.05	70.4	82.2	11.8
1/2-inch "cutoff" point						
Percentage of fibers	Percent	90.4	3.00	83.3	95.0	11.7
Mean length	Inches	1.04	.069	.87	1.27	.40
Coef. of variability	Percent	20.62	1.936	16.3	25.5	9.2
75/25 length ratio	Ratio	74.7	3.64	66.4	81.1	14.7
3/8-inch "cutoff" point						
Percentage of fibers	Percent	94.3	1.96	89.2	97.4	8.2
Mean length	Inches	1.01	.069	.84	1.24	.40
75/25 length ratio	Ratio	72.4	4.47	62.6	80.2	17.6
1/4-inch "cutoff" point						
Percentage of fibers	Percent	98.0	.773	95.2	99.0	3.8
Mean length	Inches	.99	.072	.81	1.21	.40
Coef. of variability	Percent	27.45	3.217	19.7	34.7	15.0
75/25 length ratio	Ratio	70.0	5.52	57.4	80.0	22.6
<u>Dependent variables:</u>						
1. 22s yarn skein strength	Pounds	128.6	14.59	101.0	160.2	59.2
2. 22s yarn appearance grade	Index	113.2	6.71	100.	120.	20.
3. Picker and card waste	Percent	7.03	1.46	4.98	12.81	7.83
4. 50s yarn skein strength	Pounds	45.57	6.02	34.4	59.3	24.9
5. 50s yarn appearance grade	Index	99.33	9.46	70.	120.	50.
6. Classer's length	32nd in.	33.77	2.432	29.	38.	9.

Table 9.-- Summary of beta coefficients showing the importance in relation to 22s yarn skein strength of the standard Suter-Webb array values, truncated array values for "cutoff" points of 5/8-inch, 1/2-inch, and 1/4-inch, and Fibrograph measurements

<u>Independent variables:</u>		<u>Rank</u>	<u>Beta coefficients</u>
1. Standard Suter-Webb array:			
Upper quartile length	1		+0.616 + 0.087
Coefficient of length variability	2		- .407 + .087
2. Fibrograph:			
Upper half mean length	1		+ .687 + .100
Length uniformity ratio	2		+ .335 + .100
3. Truncated array with coefficient of length variability:			
5/8-inch "cutoff" point:			
Mean length	1		+ .674 + .087
Coefficient of length variability	2		- .618 + .120
Percentage of fibers 5/8 inch and longer	3		+ .295 + .083
1/2-inch "cutoff" point:			
Mean length	1		+ .781 + .108
Coefficient of length variability	2		- .419 + .122
Percentage of fibers 1/2 inch and longer	3	1/	- .081 + .140
1/4-inch "cutoff" point:			
Mean length	1		+ .771 + .094
Coefficient of length variability	2	1/	- .217 + .088
Percentage of fibers 1/4 inch and longer	3	1/	- .132 + .096

1/ Statistically insignificant, being less than 3 times its standard error.

Table 10.--Summary of beta coefficients showing the importance in relation to 22s yarn appearance grade of the standard Suter-Webb array values, truncated array values for "cutoff" points of 5/8-inch, 1/2-inch, and 1/4-inch, and Fibrograph measurements

<u>Independent variables:</u>	<u>: Rank</u>	<u>:Beta coefficients</u>
1. Standard Suter-Webb array:	:	:
Coefficient of length variability	: 1	:1/ -0.363 + 0.123
Upper quartile length	: 2	:1/ - .066 + .123
2. Fibrograph:	:	:
Length uniformity ratio	: 1	:1/ + .082 + .136
Upper half mean length	: 2	:1/ - .060 + .136
3. Truncated array with coefficient of length variability:	:	:
5/8-inch "cutoff" point:	:	:
Percentage of fibers 5/8 inch and longer	: 1	:1/ + .399 + .141
Coefficient of length variability	: 2	:1/ - .194 + .131
Mean length	: 3	:1/ - .149 + .149
1/2-inch "cutoff" point:	:	:
Percentage of fibers 1/2 inch and longer	: 1	:1/ + .234 + .219
Coefficient of length variability	: 2	:1/ - .190 + .192
Mean length	: 3	:1/ - .088 + .169
1/4-inch "cutoff" point:	:	:
Coefficient of length variability	: 1	:1/ - .346 + .135
Percentage of fibers 1/4 inch and longer	: 2	:1/ + .099 + .148
Mean length	: 3	:1/ - .052 + .144

1/ Statistically insignificant, being less than 3 times its standard error.

Table 11.--Summary of beta coefficients showing the importance, in relation to picker and card waste, of the standard Suter-Webb array values, truncated array values for 1/2-inch "cutoff" point, and for Fibrograph measurements

Independent variables:	:Rank	:Beta coefficients
1. Standard Suter-Webb array:	:	:
Upper quartile length	: 1	: -0.507 + 0.113
Coefficient of length variability	: 2	: <u>1</u> / + .108 <u>+</u> .113
2. Fibrograph:	:	:
Upper half mean length	: 1	: - .492 + .118
Length uniformity ratio	: 2	: <u>1</u> / + .056 <u>+</u> .118
3. Truncated array with coefficient of length variability:	:	:
1/2-inch "cutoff" point:	:	:
Mean length	: 1	: <u>1</u> / - .376 + .150
Percentage of fibers 1/2 inch and longer	: 2	: <u>1</u> / - .286 + .197
Coefficient of length variability	: 3	: <u>1</u> / - .274 + .174

1/ Statistically insignificant, being less than 3 times its standard error.

